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| **Virginia Board of Education Agenda Item** | **Seal of the Commonwealth of Virginia** |

# Agenda Item: J

## Date: November 18, 2021

### Title: First Review of *Data Science Standards of Learning* and *Data Science Standards of Learning Curriculum Framework*

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## Purpose of Presentation:

Action required by state or federal law or regulation.

**Executive Summary:**   
The world in which we live is rich with data. The amount of data generated in the world has exploded and in the past ten years has increased to over 60 times the amount of data that existed in 2010. The evolution of data analysis and technology tools has changed the landscape in how we compute with data. The computing power of technology, the accessibility of data, and the applications for the use of data have evolved dramatically in the past 40 years. The growing demand for accessing and computing with data exists in all parts of society and continues to grow.

The Proposed *Data Science Standards of Learning*, an addition to the current 2016 *Mathematics Standards of Learning*,and the Proposed *Data Science Standards of Learning Curriculum Framework* are presented for first review. A high school level one-semester or year-long mathematics course can be locally developed based on the Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* and will provide an introduction to the learning principles associated with analyzing big data. Through the use of open source technology tools, it is anticipated that students participating in these courses developed from these standards will identify and explore problems that involve the use of relational database concepts and data-intensive computing to find solutions and make generalizations. Students will engage in a data science problem solving structure to interact with large data sets as a means to formulate problems, collect and clean data, visualize data, model to predict, and communicate effectively about data formulated solutions.

The Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* include the following strands:

* Data and Society - Understanding data science facilitates critical examination of questions in different parts of society and supports informed data-driven decision making.
* Data and Ethics - Ethical implications may result from the types of methods used for data collection, processing, representation, analysis, and use.
* Data and Communication - Data visualizations are used to communicate insights about complex data sets to support an audience in making decisions.
* Data Modeling - Mathematical models are used to predict future, unobserved data values.
* Data and Computing - Technology is used to effectively prepare, analyze, and communicate with data.

## Action Requested:

Action will be requested at a future meeting. Specify anticipated date below:

April 21, 2022

## Superintendent’s Recommendation: The Superintendent of Public Instruction recommends that the Board of Education receive the Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* for first review.

## Previous Review or Action:

No previous review or action.

**Background Information and Statutory Authority:**  
Data Science is an interdisciplinary field that is an intersection of mathematics, statistics, computer science, and information technology. Through an inquiry-based approach, knowledge and insights from data are applied to a broad range of other disciplines and domains. The domains in which Data Science permeates our world are so varied, from science, social studies, and business to urban planning, fashion design, and even public education. Many of the facets of society and business rely on the analysis and application of the information derived from data.

Equipping students to be able to navigate a world saturated with data requires the modernization of mathematics education. What kind of mathematics do students need to learn in the 21st century to prepare them to be data-literate citizens? Ensuring that students have the opportunity to leave high school with a basic understanding of how to visualize and interpret data, its ethical implications, and how data can be used as a catalyst for change supports the need for adding data science to the 2016 *Mathematics Standards of Learning*.

There are a multitude of K-12 Data Science Education resources from across the nation that were referenced and reviewed as the Virginia version of the Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* were developed. Prominent among these resources was the [Gaise II Framework for Statistics and Data Science Education](https://www.amstat.org/asa/education/Guidelines-for-Assessment-and-Instruction-in-Statistics-Education-Reports.aspx). The framework was developed by the National Council of Teachers of Mathematics (NCTM) and endorsed by the American Statistical Association in November 2020 and presents a “vision where every individual is confident in reasoning statistically, making sense of data, and knowing how and when to bring a healthy skepticism to information gleaned from data.”

Numerous stakeholders were consulted as the Proposed *Data Science Standards of Learning* and Proposed *Data Science Standards of Learning Curriculum Framework* were being developed. The standards development team included representatives from K-12 education, higher education, and business/industry. Feedback from other national K-12 Data Science education leaders was received, along with consultation with higher education staff at Virginia universities and colleges. Ongoing stakeholder feedback will be obtained through a public comment period pending Board of Education approval of the first review of the Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework.*

Teams of teachers and specialists will work to develop draft curricular resources that will support instruction in Data Science. Pending approval of the Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* by the Board, a limited number of school divisions during the 2022-2023 school year will pilot locally created courses of Data Science standards. Teachers involved in the pilot will receive professional development and participate in a professional learning cohort. Full implementation of the *Data Science Standards of Learning* and *Data Science Standards of Learning Curriculum Framework* will occur during the 2023-2024 school year.

Using technology tools, such as CODAP, Python, or Excel/Google Sheets, students will be collecting and cleaning data, representing and analyzing data, and building models that will allow for the examination of problems in society. Students will examine problems for which data sets may already exist, or may collect data around an authentic problem or situation.

The following tenets of student learning are incorporated in the Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework*:

* Learn through exploration of data;
* Formulate questions through data investigations (tasks/project-based);
* Choose data sets from local context and learner-interest;
* Follow a data cycle process;
* Expose students to many types of data;
* Model student’s personal experiences with data structures other than only flat data (row by column);
* Choose tools to use for data visualization and analysis;
* Communicate through posing questions, collaborating with peers, and tailoring data presentations to specific audiences; and
* Build data literacy skills to bring to postsecondary opportunities (college/career).

The Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* align to the *Profile of a Virginia Graduate,* which describes the knowledge, skills, competencies, and experiences students should attain during their K-12 education to make them “life-ready,” and prepared to succeed in the evolving economy. In a course based on the *Data Science Standards of Learning,* students will use critical and creative thinking to make predictions, through the use of varied data sources, based on the patterns and trends revealed in data. Through viewing data from authentic community contexts, students will be able to collaborate with business, industry, and government entities to support the development of citizenship.  Communication will play a key role as students communicate their conclusions and begin to build a skill set that will be vital as they pursue their postsecondary aspirations.

The Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* align to the Board of Education Priority 1 to provide high quality learning environments for all students.

The *Code of Virginia* requiresthe Board to establish educational objectives and review the Standards of Learning periodically, as referenced below:

*Code of Virginia* [§ 22.1-253.13:1](https://law.lis.virginia.gov/vacode/title22.1/chapter13.2/section22.1-253.13:1/)

B. “The Board of Education shall establish educational objectives known as the Standards of Learning, which shall form the core of Virginia's educational program, and other educational objectives, which together are designed to ensure the development of the skills that are necessary for success in school and for preparation for life in the years beyond. At a minimum, the Board shall establish Standards of Learning for English, mathematics, science, and history and social science. The Standards of Learning shall not be construed to be regulations as defined in § [2.2-4001](https://law.lis.virginia.gov/vacode/2.2-4001/).”

“The Board shall seek to ensure that the Standards of Learning are consistent with a high-quality foundation educational program. The Standards of Learning shall include, but not be limited to, the basic skills of communication (listening, speaking, reading, and writing); computation and critical reasoning, including problem solving and decision making; proficiency in the use of computers and related technology; computer science and computational thinking, including computer coding; and the skills to manage personal finances and to make sound financial decisions.”

“The Standards of Learning in all subject areas shall be subject to regular review and revision to maintain rigor and to reflect a balance between content knowledge and the application of knowledge in preparation for eventual employment and lifelong learning. The Board of Education shall establish a regular schedule, in a manner it deems appropriate, for the review, and revision as may be necessary, of the Standards of Learning in all subject areas. Such review of each subject area shall occur at least once every seven years. Nothing in this section shall be construed to prohibit the Board from conducting such review and revision on a more frequent basis.”

New academic content Standards of Learning for mathematics were first developed in 1995.  Pursuant to legislation from the 2000 Virginia General Assembly, the Board established a seven-year cycle for review of the Standards of Learning. As a result, the 1995 *Mathematics Standards of Learning* were reviewed in 2001, 2009 and 2016. This addition to the 2016 *Mathematics Standards of Learning* will form a part of extensive review of all standards in 2023.

The *Mathematics Standards of Learning* identify academic content for essential components of the mathematics curriculum at different grade levels for Virginia’s public schools. The *Mathematics Standards of Learning Curriculum Framework*, a companion document to the *Mathematics Standards of Learning*, amplifies the standards and further defines the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The standards and curriculum framework are not intended to encompass the entire curriculum for a given grade level or course. School divisions are encouraged to incorporate the standards and curriculum framework into a broader, locally-designed curriculum. The curriculum framework delineates in greater specificity the minimum content that all teachers should teach and all students should learn.

**Timetable for Further Review/Action:**  
Following the Board’s acceptance of the Proposed *Data Science* *Mathematics Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* for first review, the Department of Education will receive public comment for at least 30 days. The Proposed Revised *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* will subsequently be brought to the Board for final review in April 2022. During the public comment period, the Board will host two public hearings on the Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* at the following times/locations:

* January 11, 2022 – 6:30 p.m.-7:30 p.m.

[Public Hearing – Proposed Data Science SOL Zoom Meeting Registration 1/11/2022](https://doe-virginia-gov.zoom.us/j/85038824728?pwd=TE1WSnVTY2tDMURKRmNJTEdpV0VzZz09)

* January 20, 2022 – 6:30 p.m.-7:30 p.m.

Public Hearing - Location To Be Determined

It is anticipated that the review and revision process will be completed in the spring of 2022 and the document will be posted for school divisions via the VDOE website.

## Impact on Fiscal and Human Resources:

The collection and analysis of public comment and additional revisions to the Proposed *Data Science Standards of Learning* and the Proposed *Data Science Standards of Learning Curriculum Framework* along with professional learning for the pilot implementation can be absorbed by the agency’s existing resources at this time. If the agency is required to absorb additional responsibilities related to this activity, other services may be impacted. School divisions may be impacted by providing release time for teachers to participate in professional learning.